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ABSTRACT

This paper describes the concept and implementation of a collaborative learning platform for school education over the Internet. The authors called this platform the "eTrip System," because they applied it to a school field study. Using information technologies, it supports the whole learning flow for a field trip: pre-trip learning; hands-on learning; and post-trip learning. It enables students to learn more effectively and more vigorously by providing them with a collaborative environment based on a student-extended database and electronic bulletin board. The system was evaluated experimentally for a field trip by senior high school students. (Contains 13 references.) (Author/MES)

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Development of eTrip System: Collaborative Learning Platform for a Field Trip

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Abstract: *This paper describes the concept and implementation of a collaborative learning platform for school education over the Internet. We call this platform the "eTrip system" because we applied it to a school field study. Using information technologies, it supports the whole learning flow for a field trip: pre-trip learning, hands-on learning, and post-trip learning. It enables students to learn more effectively and more vigorously by providing them with a collaborative environment based on a "student-extended database" and "electronic bulletin board". We evaluated the system experimentally for a field trip by senior high school students.*

1. Introduction

It has been argued that students learn best when given the opportunity to learn skills and theories in the context in which they are used, and then construct their interpretations of the subject and communicate their understanding to others (Resnick, 1987). Therefore, field studies have attracted much attention because they give students that opportunity. In Japan, school education has been changing recently as a result of national policies which intend to introduce "integrated study" styles into the curriculum from 2002. "Integrated study" aims to help children develop the capacity and ability to discover problems by themselves and solve them appropriately. This notion is similar to the project-based curriculum in the United States.

With this change in education, the field trip in Japan has been changing, too. On a typical senior high school field trip, students used to go somewhere for about four days and three nights to learn with some specific purposes. Until a few years ago, these purposes were usually just to go sightseeing and add to their general knowledge, but recently they have tended to be to study and experience as part of integrated studies. Students explore some learning themes such as the culture and history of their destination before the trip (pre-trip learning). Then they go there and learn from various experiences (hands-on learning). After the trip, they put their thoughts together and present them to the class (post-trip learning).

With this background we have developed an eTrip system that supports the whole learning flow in the field trip with information technologies. This system enables students to learn more effectively by providing them with an environment for collaborating with other students. This system features a "student-extended database" and "electronic bulletin board" to extend learning opportunities. In this paper, we describe the concept and implementation of the eTrip system and report the results of an experiment.

2. Basic Design of the eTrip System: Collaborative Learning Platform

We think it is important for students to prepare a common learning framework with other students, teachers, or experts. In developing the eTrip system, we considered the following design guidelines to facilitate collaborative learning over the Internet.

1. Archive their learning and experiences and make them public
2. Share them with all students and understand them
3. Discuss vigorously with others and broaden their knowledge.

Figure 1 shows the concept of the system. This system uses a client-server model and everybody can access it via the Internet. Using the database, they can write reports about their learning or experiences and send them to the database easily using a template in a browser. They can also retrieve other people's reports and educational materials from the database by searching with some conditions such as the learning themes. Using the bulletin board, of course, other students, teachers, and experts can participate in this system and discuss with students. The database and the bulletin board are linked by each learning theme.

This concept is applicable not only to field trips but also to various types of problem-based learning. We have already developed an Internet-based content-growing encyclopedia, called "CyberPedia", which has been successfully applied to aquatic microorganism observation, periodical tree growth observation, and so on (Kura et al., 2001).

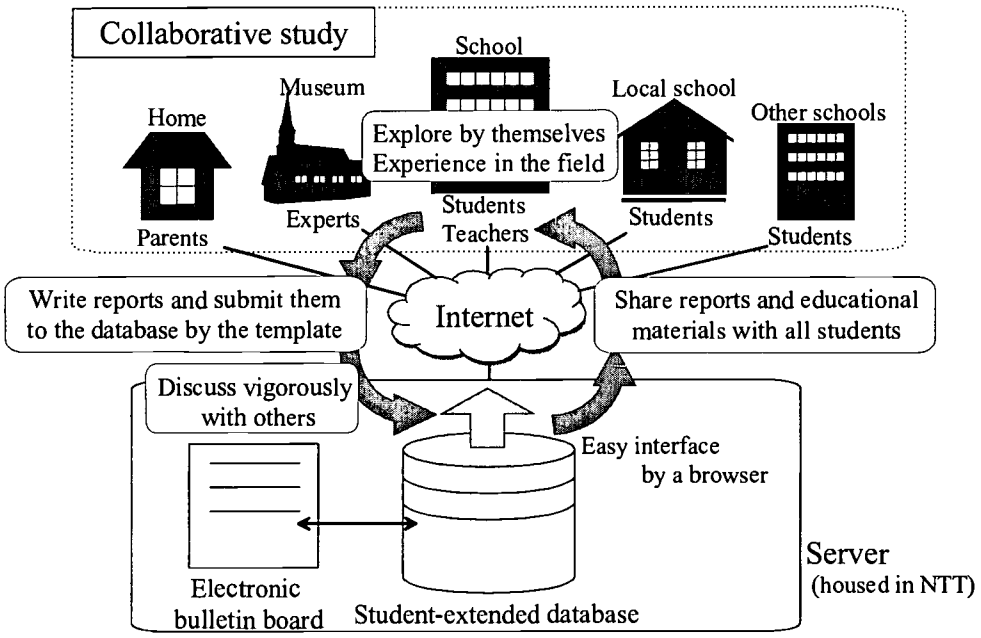


Fig. 1 Concept of a collaborative learning platform on the Internet.

3. Implementation of the eTrip System

3.1 Pre-trip learning system - collaborative learning process

The main purposes of the pre-trip learning are to explore the learning themes using the Internet or books in advance and to make plans for what to do at the destination. On Japanese field trips, students are permitted to perform free activities in groups of four or five. So, they plan their schedule by themselves according to the learning theme. Figure 2 illustrates an overview of the pre-trip learning system we developed. It has three main functions.

(1) Search for information in the database

This system works with most browsers and has a good structure that is easy to understand. This window consists of three frames. The left one is for specifying the search conditions, the middle one lists the search results, and the right one displays details of a result. Each result has some items such as learning theme, key-words, and locations and can be retrieved by them. The learning theme, for example, geography and nature, culture, and history, are registered by administrators beforehand. More detailed keywords, for example, coral reef and food or plant names, are registered by students. The results of the search are listed in the middle frame and are linked with icons on the map. The position data is very useful for students when they are making plans. They can also search for data by specifying areas on the map. The details of one result, for example, a reference URL and comments, are displayed in the right frame. Of course, we need some initial contents in the database, but not a lot by design, because the next function is to build up the contents.

(2) Submit reports to the database

Students can get some information from the database, but to get more details, they must seek it by themselves using the reference URL and various search engines. The most important thing here is to share the information that they find with all their fellow students. This sharing is a big motivation for students to study more. Each student enters the results of his/her studies into the database and other students can look at them from the database. So, we call this a "student-extended database". It is easy for students to submit to the database because all they have to do is fill out the template and click the submit button in the browser.

Our system does not make the students' data public immediately. Teachers can check and approve it in a browser before it is opened to the public over the Internet. In other words, teachers act as filters between students and the Internet. This confirmation work is rather a burden for teachers, but the benefit is that they can correct mistakes made by students before the work is put on the Internet.

(3) Discussion by electronic bulletin board

Electronic bulletin boards are set up for each learning theme. Many students at different schools and some experts can participate. When students have a question about local subjects before a trip, they can easily ask the students at a local school.

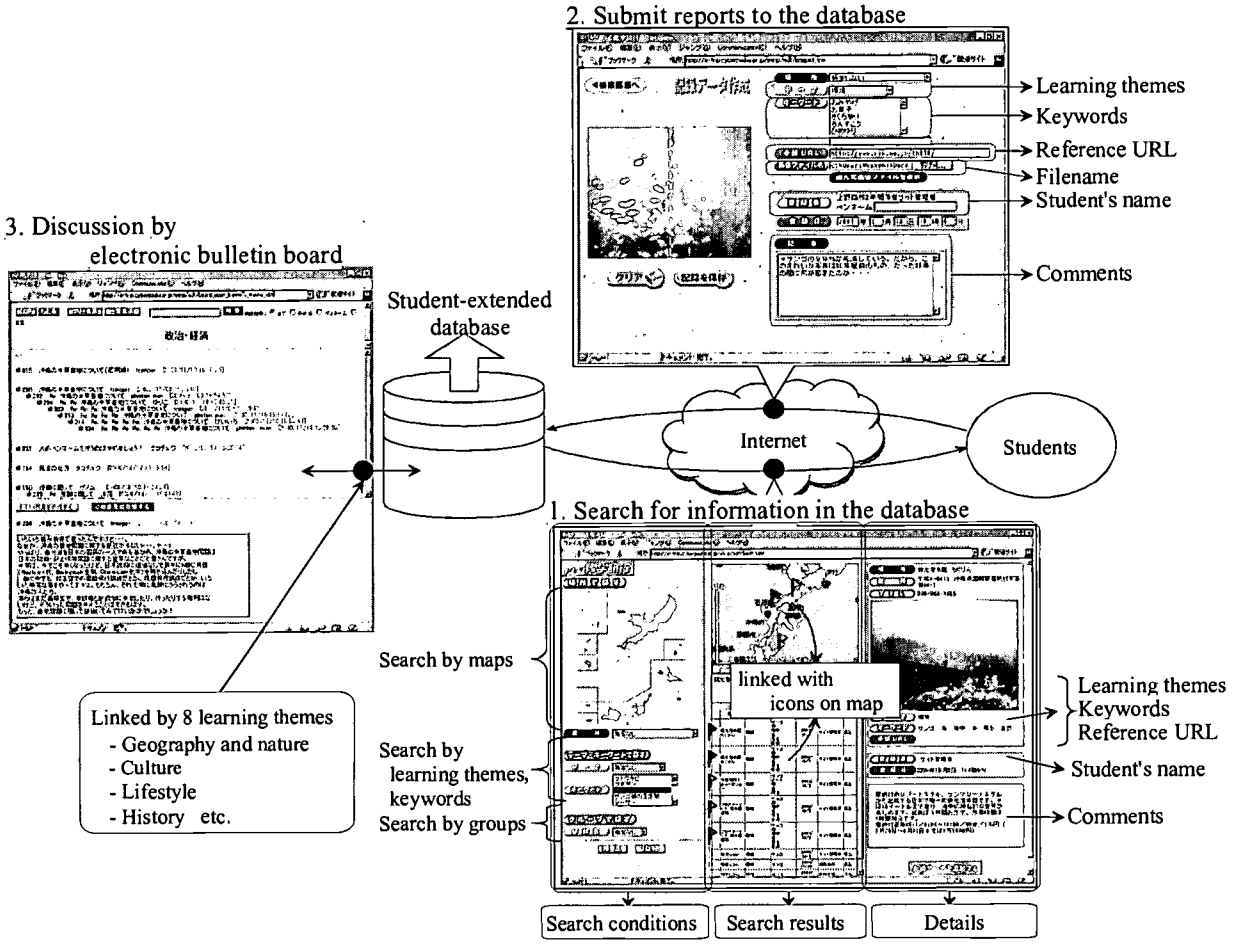


Fig. 2 Overview of the pre-trip learning system.

3.2 Hands-on learning system

The main purposes of the hands-on learning are to experience something at the destination and to record these experiences before they are forgotten. Some systems that support field studies by hand-held devices have already been developed (Rieger et al., 1997, Pascoe et al., 1998). We recognize the importance of hand-held devices, but it will be difficult for students to use them. So, we considered ease-of-use as being the most important factor in the field study. Figure 3 illustrates an overview of the hands-on learning system.

(1) Record the experience

When students go out on a field trip, they each take a bag containing a digital camera, a pocket GPS, a notepad, and a cellular phone. These enable them to accurately record the day's activities and help them arrange their thoughts later. The pocket GPS continuously tracks the path taken by a student and the notepad lets him/her write down thoughts on the spot. Moreover, the GPS and cellular phone are useful items of safety equipment in case of emergency. After they get back to the school or hotel, they can transfer pictures and GPS data to computers and send them to the server. At this stage, the pictures are not openly available to others on the Internet.

(2) Submit reports to the database via the template

When the server receives data from the camera or GPS, it automatically inputs it to the database and presents a template for students to enter their comments. This template is shown in Fig. 3. It is implemented in Java and runs in the browser. The left frame shows all the data of the day's activities. The path recorded by the GPS is plotted on the map and a sequence of thumbnail pictures is displayed below the map. The positions where the pictures were taken are automatically indicated by icons on the map, because they were calculated in advance by matching the time stamps between these two data sources. This helps students remember where and what they experienced. In the right frame, they can input the title, the learning themes, keywords, and comments about each picture. They can also set whether each item of data is public or private on the Internet. The default is private, so only data that they want to show is made public. Thus, parents can follow their children's activities from home via the Internet.

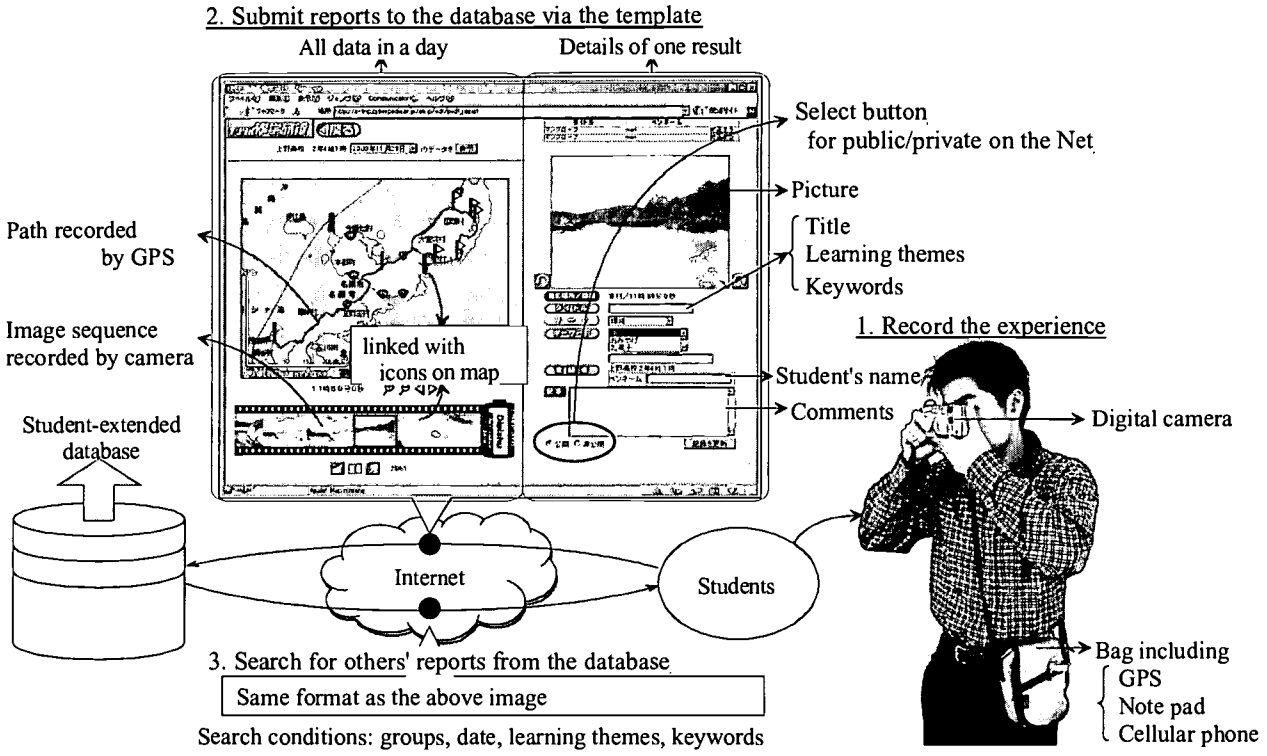
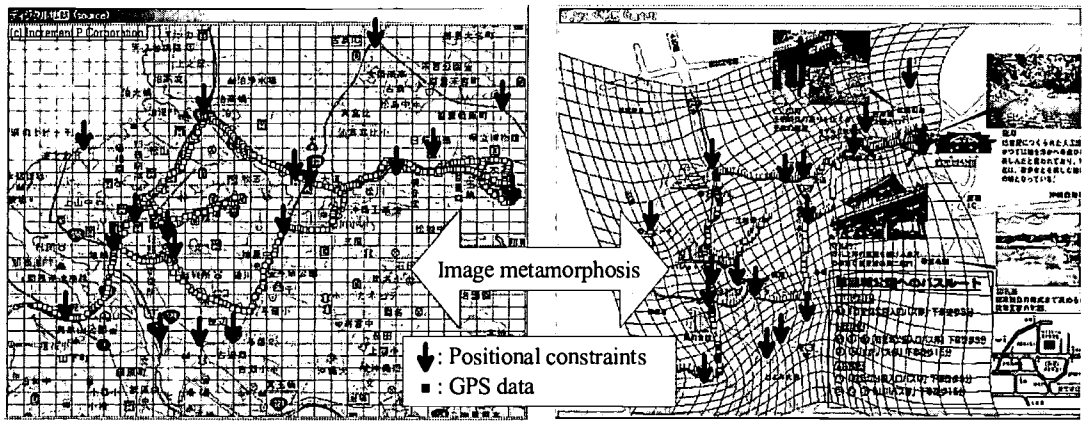


Fig. 3 Overview of the hands-on learning system.



(a) geographically accurate map (b) geographically inaccurate map (schematic map)

Fig. 4 Map deformation between an accurate map and inaccurate map.

This system uses maps obtained via the Internet from a map database that covers the whole country, so it works anywhere in Japan. Alternatively, geographically inaccurate maps such as schematic sightseeing maps can also be used in our system. A sightseeing map is intuitively easier to understand because it is simplified. We have developed a map deformation technique for converting between geographically accurate and inaccurate maps. This technique makes use of the image metamorphosis method (Lee et al., 1996). So, we can calculate the correspondence between two different maps. If you specify some points such as main buildings and crossroads in both maps, GPS data can be automatically plotted in the inaccurate map. Figure 4 shows an example of this map deformation.

(3) Search for others' reports from the database

It is usually difficult to find out later what other groups did. But the eTrip system allows all experiences of all groups to be archived and shared in the database. So, students can easily understand what other groups did or how they felt on the spot by performing a group search or learning theme search of the database.

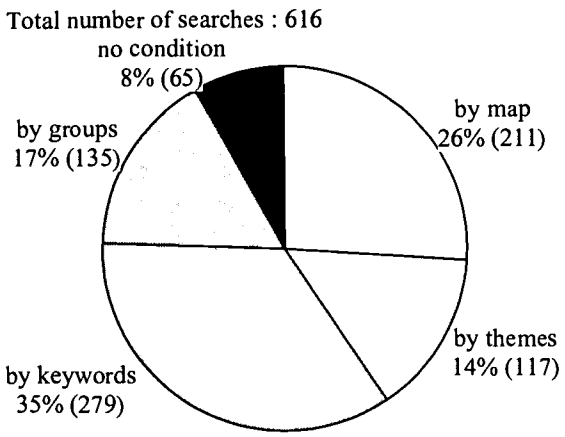


Fig. 5 Searching styles in pre-trip learning.

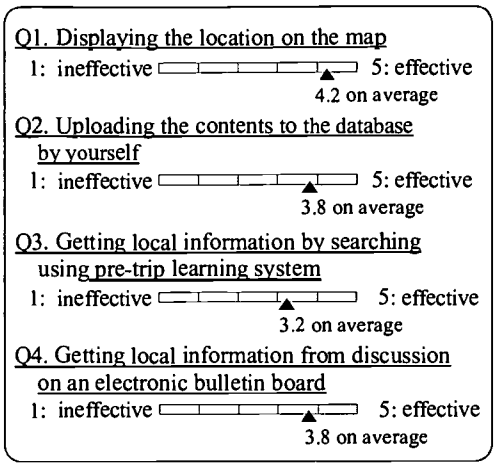


Fig. 6 Results of questionnaires on pre-trip learning.

3.3 Post-trip learning

The main purposes of the post-trip learning are to get students to reconsider the learning themes and put their thoughts together through their experiences. We have developed a collaborative editing board over the Internet (Sugiyama, 2001). This enables students to make reports in a free format by groups. It brings out more creativity from students. These reports are presented over the Internet, so anybody can access and look at them.

4. Experiment and Evaluation

4.1 Experiment

We conducted an experiment to see how students actually learn with our system. About 15 groups of senior high school students in Tokyo participated in this experiment. They went to Okinawa on a field trip in 2000. Although Okinawa is only a small island, it has a unique history, distinctive culture, and rich natural environment, so it is a major destination for field trips.

They performed preliminary learning about Okinawa (10/10-11/17), went there (11/21-11/24), and made reports and presented them to the class (11/27-2/7). They also discussed various things about Okinawa, such as the problems related to the U.S. military bases, with the local students using the electronic bulletin board. This experiment was not part of the curriculum, but a voluntary after-school activity.

Since our system uses a client-server environment, a school only needs browsers and Internet access. The access line to the server was 128 kbps. In the hands-on learning, students uploaded their experiences from the hotel in Okinawa. The server, which was located in an NTT facility, used WindowsNT Server as the operating system and Oracle as the database. We are making a version using Linux and PostgreSQL. Access to our web site is restricted by user ID and password in consideration of the student privacy policies.

4.2 Evaluation of the pre-trip learning system

We examined how students dealt with the pre-trip system from the access logs. Figure 5 shows the breakdown of conditions that students used for searching. They made plans by map search (26%), explored local subjects by either the learning theme or keyword search (49%), and found out what their friends were learning (17%). These results mean that all the search functions were useful for students. Figure 6 shows the results of questionnaires for 20 students. They clearly show it was effective for students to get the location of the results on the map.

Students uploaded contents that they found by themselves into the database through the Internet. Unfortunately, the number of such data uploads was not so large (about 30). We suppose this was because the experiment was held as a free activity after school. According to interviews in which we asked the students whether uploading to the database was interesting or not, they gave it a score of 3.8 out of 5 on average. They were very interested in sharing the results of their learning with everyone else.

In the pre-trip learning, students used the electronic bulletin board a lot. They exchanged many comments (about 150) and accessed other people's comments. In particular, it really came alive after local students in Okinawa joined in. One typical comment from the students was "It is really useful to get hot news and opinions from local students directly."

4.3 Evaluations of the hands-on learning system

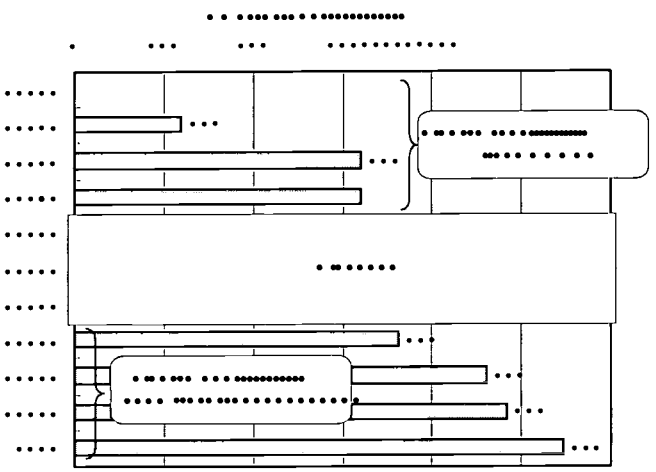


Fig. 7 Chronology of data uploads in hands-on learning.

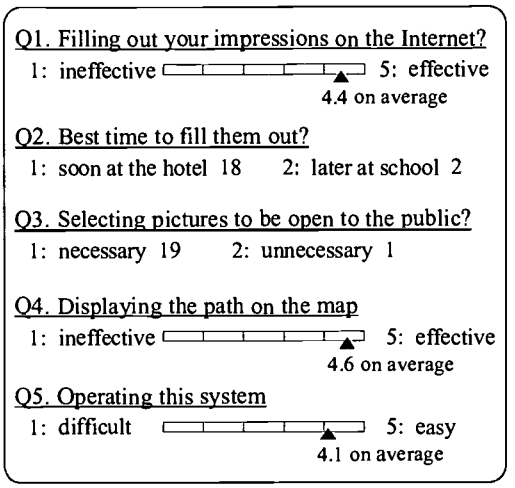


Fig. 8 Results of questionnaires in hands-on learning.

Students had an enjoyable and serious time recording their experiences with digital cameras in the daytime and adding comments to the pictures in the evening. Almost all of them made comments like "It is very effective to write comments before they slip from memory" and "it is exciting to make our experiences openly available on the Internet." Even though the work of writing comments was done in their free time in the evening, many of them were enthusiastic about spending two hours or more on it. That was a surprise to us.

Figure 7 shows the chronology of the data uploads in the hands-on learning. The total number of the data uploads was more than 500 and the students continued updating their experiences back at school and home after returning to Tokyo. That was also a big surprise to us.

Figure 8 shows the results of the questionnaires for 20 students. The results demonstrate that this system is useful, exciting, and easy for students to use as all the scores were more than 4 points. In particular, students said that choosing to make the pictures openly available on the Internet was absolutely necessary.

5. Conclusions and Future Work

We outlined our eTrip system, which supports the whole learning flow for a field trip. The system is designed to give students an environment for collaborating with other students or local schools. It is characterized by a "student-extended database" and "electronic bulletin board." The results of our experiment show that it was effective and exciting for students to put their experiences together and make them public on the Internet with our eTrip system. And the electronic bulletin board was also used a lot especially before the trip. It enabled students to get useful information from local students.

In the future, we will extend this system to improve the integration of the pre-trip, hands-on, and post-trip learning. For example, we think that students should be able to retrieve the contents that they examined in advance on the spot and to put their thoughts together easily via a template comparing the contents of the pre-trip and hands-on learning. Moreover, we want to apply this system to other subjects such as environment or geography education to archive the learning on the map by students.

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